



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Technology Validation

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**Energy Efficiency and Renewable Energy
Hydrogen, Fuel Cells and Infrastructure Technology Program
FORS 5G-086**



Technology Validation Technical Goal & Objectives

Goal : Demonstrate and validate integrated hydrogen and fuel cell technologies in a systems context under real operating conditions.

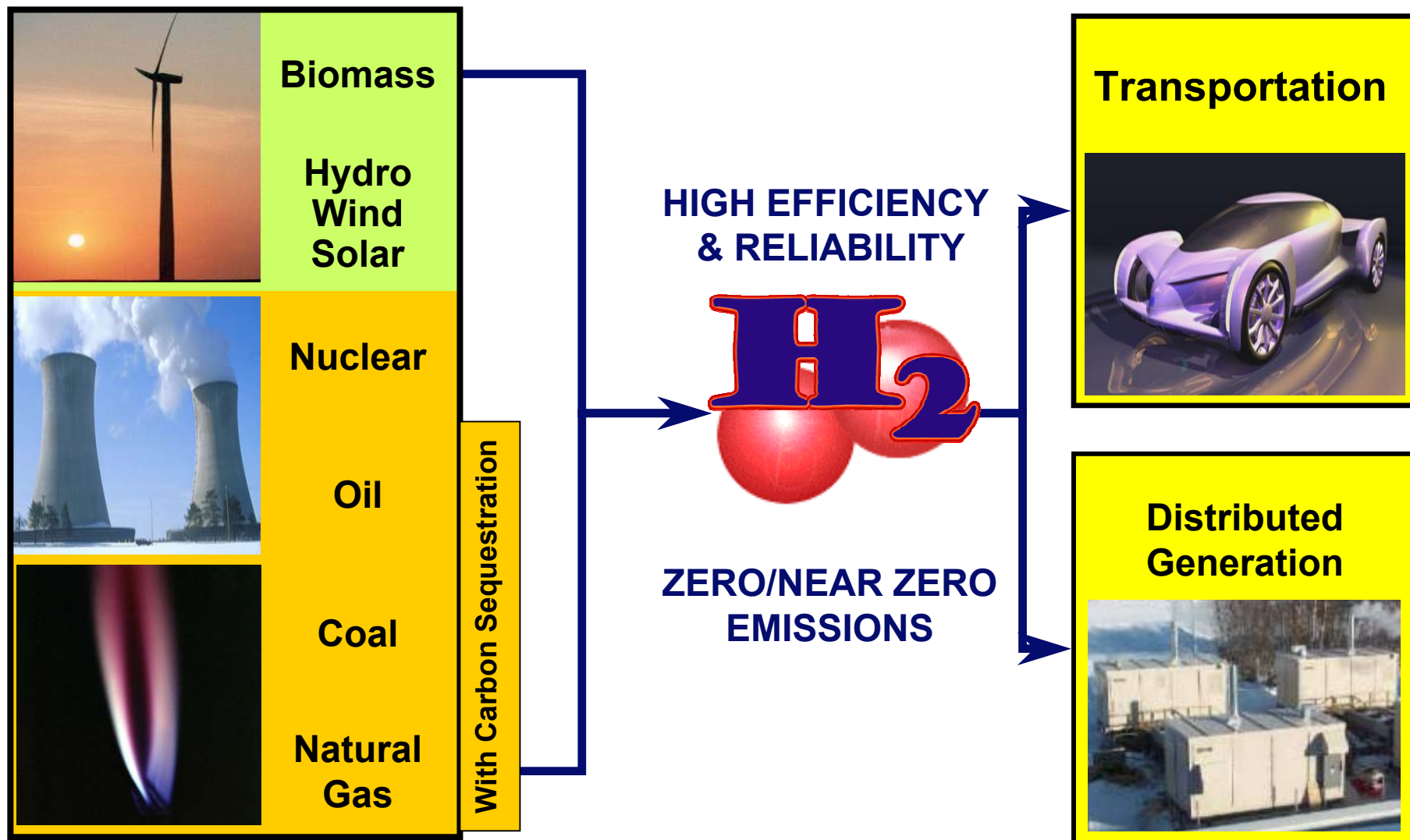
Objectives

- By 2007, validate an electrolyser at a capital cost of \$300/kWe when built in quantity that is powered by a wind turbine.
- By 2008, validate hydrogen vehicles with greater than 250 miles range, 2,000 hour fuel cell durability, and \$3.00/gallon (gasoline equivalent) hydrogen production cost (untaxed) and vehicles that can be safely and conveniently refueled by trained drivers.
- By 2008, validate stationary fuel cell and hydrogen ICE systems that co-produce hydrogen and electricity from non-renewable and renewable resources, and demonstrate 30,000 hour durability, greater than 32% efficiency and a price of \$1,250/kW or less (for volume production).
- By 2010, validate an integrated biomass/wind or geothermal electrolyzer to hydrogen system to produce hydrogen for \$3.30/kg at the plant gate (untaxed and unpressurized).



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Why Hydrogen? It's abundant,
clean, efficient, and can be derived
from diverse domestic resources.





BARRIERS

- Vehicle – Data needed on fuel cell durability, fuel economy, and vehicle maintenance and operation for validation
- Storage – Cost, durability, fast-fill and discharge performance, and structural integrity need to be validated
- Hydrogen Refueling Infrastructure – Cost, sensor durability and refueling times need to be validated
- Hydrogen and Electricity Co-production – Need to validate the cost and durability for the co-production of hydrogen and electricity
- Maintenance and Training – Lack of facilities for maintenance and untrained personnel for hydrogen vehicles
- Codes and Standards – Lack of adopted codes and standards to permit the deployment of refueling stations
- Hydrogen from Fossil, Nuclear, and Renewable Resources – Lack of data on cost, efficiencies and durability of these systems



Characteristics	Units	2003	2008	2015
<u>Vehicles</u>		Status		
Fuel Cell Stack Durability	Hours	1,000	2,000	5,000
Range	Miles		250	300
Hydrogen Cost	\$/kg of H ₂	4.50	3.00	1.50
<u>Co-Production option</u>				
Cost	\$/kw	2,500	1,250	750
Durability	Hours	15,000	30,000	40,000
Electrical Efficiency of Fuel Cell	%	30	32	40



- | | Infrastructure | Vehicle |
|---------------------------|---|---------|
| • FY03 enacted: | \$10M | \$1.8M |
| • FY04 request: | \$13.1M | \$15M |
| • Key research partners – | Auto manufacturers, energy companies, hydrogen suppliers, fuel cell suppliers, universities, Air Products, Quantum Technologies, UOP, Univ of Texas, Proton Energy, Hawaiian Electric, Detroit Edison, Arizona Public Services, Zoot Enterprises. | |



- Issued Solicitation for the Hydrogen Fleet and Infrastructure Demonstration and Validation Project
- Awarded Power Parks Project to Hawaiian Electric Company, Detroit Edison and Arizona Public Services
- A fuel cell mine locomotive is being evaluated by the Fuel Cell Propulsion Institute and Vehicle Projects LLC



Technology Validation: Key Milestones

Task	Description	Date (FY)
1,2 and 4	Awards made to start fuel cell vehicle/infrastructure demonstration activity and for hydrogen co-production infrastructure facilities.	3Q, 2004
1	Validate fuel cell demonstration vehicle range of ~200 miles and durability of ~1,000 hours.	4Q, 2006
2	Five stations and maintenance facilities constructed with advanced sensor systems and operation procedures.	4Q, 2006
3	Validation of \$3/gallon equivalent hydrogen cost	1Q, 2006
4	First regional network in operation with fuel cell system that project < \$2500/kW	1Q, 2007
5	Validation of \$3.30/gallon equivalent price hydrogen from biomass/wind (untaxed & pressurized)	3Q, 2010
6	Results from analysis of examination of synergies from combining hydrogen and electricity energy carrier systems, including advanced power parks.	2Q, 2006



- Controlled hydrogen fleet and infrastructure solicitation (including co-production option) closes August 14, 2003 - Selections 4th quarter 2003
- Validation of 2010 vehicles, storage, codes and standards, and co-production targets
- Validation of hydrogen from renewable, nuclear and coal
- Validation of delivery systems